REMARKS

In the Final Office Action, the Examiner rejected claims 1-11 and 29-31. The present Response neither amends nor cancels any claims. As such, claims 1-11 and 29-31 remain pending in the present application and are believed to be in condition for allowance. In view of the following remarks, Applicants respectfully request reconsideration and allowance of all pending claims.

Preliminary Remarks Regarding the References Cited by the Examiner

As a preliminary matter, Applicants note that the pending claims were previously rejected by the Examiner in the Office Action mailed on September 14, 2009 under either Section 102 or 103 based upon Göttert et al., U.S. Patent No. 6,482,553 (hereinafter "Göttert"). *See, generally,* Office Action mailed 9/14/2009 (hereinafter "Previous Office Action"). In response to the amendments and remarks submitted by Applicants in the Response filed on November 10, 2009 (hereinafter "Previous Response"), the Examiner withdrew the previous rejections based upon Göttert, but maintained the rejection of the pending claims in the present Final Office Action based upon a newly cited reference, Akram et al., U.S. Patent No. 5,609,995 (hereinafter "Akram"). *See* Final Office Action, page 7.

With this in mind, Applicants note that both of the Göttert and Akram references were cited during the prosecution of U.S. Patent Application Serial No. 11/215,938, which is a divisional application (hereinafter the "Divisional Application") that claims priority to the instant application. For instance, in an Office Action mailed on November 29, 2007 and a Final Office Action mailed on June 28, 2008, several claims of the Divisional Application were rejected by Examiner Shawntina Fuqua as being unpatentable under Section 103 based upon the combination of Göttert and Akram. *See* Divisional Application File Wrapper History, Office Action mailed 11/29/2007, Final Office Action mailed 6/28/2008. Further, it is noted that in responding to the rejections

set forth in the above-mentioned Office Actions, Applicants argued the allowability of the Divisional Application's claims over the proposed combination of Göttert and Akram without amending the claims.

Applicants' arguments regarding the rejections of the Divisional Application's claims based on Göttert and Akram were eventually presented to a Panel in conjunction with a Pre-Appeal Brief Request for Review filed on September 26, 2008. *See* Divisional Application File Wrapper History, Pre-Appeal Brief Request for Review filed 9/26/2008. After reviewing the rejections based upon Göttert and Akram, the Panel issued a Decision instructing the Examiner to reopen prosecution. *See* Divisional Application File Wrapper History, Panel Decision mailed on 12/9/2008. Thereafter, the rejections of the Divisional Application's claims based upon Göttert and Akram were withdrawn, and the Divisional Application ultimately issued as U.S. Patent 7,605,350 on October 20, 2009.

While Applicants appreciate that the prosecution of the Divisional Application is not necessarily binding on the Examiner with regard to the prosecution of the instant application, Applicants nonetheless believe it is worth noting that Examiner Fuqua determined the Divisional Application's claims, which recite the two-bake systems that operate in a manner generally corresponding to the wafer soft-baking methods recited by the claims of the instant application, to be allowable over both Göttert and Akram. In view of this fact, it is Applicants' belief that the claims pending in the instant application are also allowable over Akram, as discussed in detail below.

Rejections under 35 U.S.C. § 102

In the Office Action, claims 1, 2, 5, 6, 8-10 and 30 were rejected by the Examiner under 35 U.S.C. § 102(b) as being anticipated by Akram. Applicants respectfully traverse these rejections.

Legal Precedent

Anticipation under Section 102 can be found only if a single reference shows exactly what is claimed. *See Titanium Metals Corp. v. Banner*, 227 U.S.P.Q. 773 (Fed. Cir.1985). For a prior art reference to anticipate under Section 102, every element of the claimed invention must be identically shown in a single reference. *See In re Bond*, 15 U.S.P.Q.2d 1566 (Fed. Cir.1990). That is, the prior art reference must show the *identical invention "in as complete detail as contained in the ... claim"* to support a *prima facie* case of anticipation. *Richardson v. Suzuki Motor Co.*, 9 U.S.P.Q. 2d 1913, 1920 (Fed. Cir. 1989) (emphasis added). Thus, for anticipation, the cited reference must not only disclose all of the recited features but must also disclose the *part-to-part relationships* between these features. *See Lindermann Maschinenfabrik GMBH v. American Hoist & Derrick*, 221 U.S.P.Q. 481, 486 (Fed. Cir.1984). Accordingly, Applicants need only point to a single element or claimed relationship not found in the cited reference to demonstrate that the cited reference fails to anticipate the claimed subject matter.

Brief Discussion of Certain Disclosed Embodiments

The present application relates generally to a two-step bake process for manufacturing semiconductor wafers. In certain embodiments, the process includes first baking a wafer at a low-bake temperature, and subsequently baking the wafer at a high-bake temperature to prevent interlayer dielectric (ILD) or photoresist layer outgassing. *See* Application, Abstract. When a semiconductor wafer with features is coated with an ILD material or resist, pockets of air or voids may be trapped under the ILD or resist layer and between some of the features. *See id.* at page 4, lines 11-19. During soft-bake processing, air in the unfilled voids may burst through the covering layer, leaving behind surface voids or craters. *See id.* at page 5, lines 2-9. Though some outgassing may be prevented by applying large quantities of ILD material to fill in the voids, this inefficient practice may result in the excessive use of ILD material and may not prevent the formation of resist craters. *See id.* at page 5, lines 11-16.

In lieu of applying excessive amounts of coating to fill all voids prior to soft-baking, the present application discloses applying an ILD coating 16 and/or a photoresist layer 18 over dense features 14A and 14B on a semiconductor wafer 10, such that voids 20 and/or 27, filled with air rather than a coating, remain beneath. *See id.* at page 7, line 20 – page 8, line 6; Fig. 1. Because a single-step soft bake process may cause the air in the unfilled voids 20 and/or 27 to outgas and, accordingly, to cause surface voids or craters in the semiconductor wafer 10, the semiconductor wafer 10 may be subjected to a two-step soft bake process, which includes first baking the wafer 10 at a lower temperature (e.g., between 30-75 °C), and then baking the wafer 10 at a higher temperature (e.g., between 100-130 °C). *See id.* at page 9, lines 12-21; Figs. 2-3. Using the two-step soft bake process, "[r]esist craters are eliminated, with or without a consecutive ILD layer, and with more or less ILD material." *Id.* at page 9, lines 20-21.

After the two-step baking process is performed, the unfilled voids 20 and/or 27 may remain in the semiconductor wafer 10 without having caused surface voids or craters; this may be explained by at least two theories. *See id.* at page 10, lines 1-13. According to a first theory, the lower bake temperature may strengthen the resist layer 18 without providing enough energy to cause air in the voids 20 and/or 27 to push through the resist layer 18. *See id.* In accordance with a second theory, the lower bake temperature may allow the resist layer 18 to remain fluid, such that air from the voids 20 and/or 27 may pass through the resist layer 18, but the resist layer 18 may flow back to its original shape. *See id.*

Akram is missing features recited by Independent Claim 1

With the foregoing in mind, independent claim 1 recites a method of soft-baking a semiconductor wafer comprising, *inter alia*, "soft-baking a semiconductor wafer comprising a substrate having a plurality of features formed thereon at a first temperature for a first predetermined period of time, wherein the plurality of features is coated with a resist such that at least one unfilled void is present under the resist and between two of

the plurality of features." (Emphasis added). Thus, independent claim 1 recites that at least one unfilled void is present under the resist and between two features of the semiconductor wafer for the duration of the recited first soft-baking step (e.g., act (a)). This feature is believed to be absent from Akram.

Akram generally relates to a method for forming a thin layer of resist on a non-planar silicon wafer. *See* Akram, col. 1, lines 5-10. As generally illustrated in Fig. 1 of Akram, such a method may include dispensing a resist 34 on a substrate 24 (e.g., step 10), spinning the substrate to spread the resist 34 (e.g., step 12), and vibrating the substrate 24 to fill voids in the resist 34 (e.g., step 14). *See id.* at Fig. 1. The method shown in Fig. 1 also includes an optional step (16) of inverting and vibrating the substrate 24 to help further distribute the resist 34. Particularly, Akram states "[b]y vibrating the substrate 24, the voids are filled in and a more uniform distribution pattern for the layer of resist 34 is achieved." *Id.* at col. 5, lines 49-52. Next, *subsequent* to step 14 and the optional step 16 (if performed), the substrate 24 (with any voids between raised features 26 having already been filled) is subjected to heating to partially harden the resist (e.g., step 18). Particularly, Akram states that the step of partially hardening the resist facilitates subsequent edge bead removal and back side washing (e.g., step 20 of the method shown in Fig. 1). *See id.* at col. 6, lines 25-35. Subsequent to the edge bead removal and back side washing of step 20, the substrate 24 is subjected to a soft-baking step 22 to dry excess solvents used in step 20 and to anneal stresses in the resist layer 34 so that the resist 34 can be exposed and developed (e.g., etched to form conductive traces in an underlying conductive layer 30). *See id.* at col. 6, lines 46-62.

With this in mind, Applicants note that in setting forth the present rejection, the Examiner equated step 18 of partially hardening the resist with the recited first soft-baking step (e.g., act (a)) recited by independent claim 1, and equated step 22 of soft-baking the resist with the second soft-baking step (e.g., act (b)) recited by independent claim 1. *See* Final Office Action, page 2. However, as discussed above, Akram clearly

states that the asserted first soft-baking step (step 18) is performed *only* after the vibrating steps of 14 and 16 (optional), which cause any voids present between the raised surface features 26 to be filled with the resist 34. *See* Akram, col. 5, lines 49-52, Fig. 4. In other words, the asserted first soft-baking step of Akram is applied to a semiconductor wafer that does not include an unfilled void under a resist and between two features, as any such voids would have already been *filled* by the acts of vibrating the substrate 24 (e.g., steps 14 and 16). Thus, in sharp contrast to the subject matter recited by independent claim 1, Akram does not teach or suggest "soft-baking a semiconductor wafer that comprises a substrate having a plurality of features ... coated with a resist such that at least one unfilled void is present under the resist and between two of the plurality of features." (Emphasis added).

In view of these deficiencies, among others, no *prima facie* case of anticipation is believed to exist with regard to independent claim 1 based upon Akram. Accordingly, Applicants respectfully request that the Examiner withdraw the Section 102 rejection and allow independent claim 1 and those claims depending therefrom.

Akram is missing features recited by Independent Claim 30

Independent claim 30 recites a method for soft-baking a semiconductor wafer comprising: "(a) soft-baking a substrate having a plurality of features coated with a resist at a first temperature for a first predetermined period of time using a first thermal unit; and (b) after act (a), soft-baking the substrate at a second higher temperature for a second predetermined period of time using a second thermal unit." (Emphasis added). Thus, independent claim 30 clearly recites that the temperature at which the substrate is soft-baked in step (b) is higher than the temperature at which the substrate is soft-baked in step (a). This feature is also believed to be absent from Akram.

As discussed above, in setting forth the present rejection, the Examiner asserted the step 18 of partially hardening a resist as being the recited soft-baking act of step (a)

(e.g., a first soft-baking step) and further asserted the subsequent step 22 of soft-baking the substrate as being the recited soft-baking act of step (b) (e.g., a second soft-baking step). However, based the Examiner's interpretation, it does not appear that Akram discloses that the soft-baking step 22 necessarily occurs at a higher second temperature compared to the partial hardening step 18, as recited by independent claim 30. For instance, with regard to each of these steps, Akram states that the partial hardening process at step 18 and the soft-baking process at step 22 both occur at temperatures of between 60 to 120 °C. *See* Akram, col. 6, lines 29-56.

As the Examiner will appreciate, this teaching alone does not disclose that the temperature used for the asserted second soft-baking step (step 22) is *necessarily* higher than the temperature used during the asserted first soft-baking step (step 18). For instance, while these particular teachings of Akram may indicate the mere possibility that the temperature used for the asserted second soft-baking step *could* be higher than the temperature used for the asserted first soft-baking step, these teachings also equally suggest that the temperature used for the asserted second soft-baking step could be lower than or equal to the temperature used for the asserted first soft-baking step. In other words, the mere disclosure that these two temperatures may have the same range (e.g., 60 to 120 °C) does not reasonably convey that one temperature is necessarily higher than the other. In fact, because the temperature ranges disclosed in Akram are identical, the relativity of the temperatures is completely absent from the teachings of Akram. As such, the teachings of Akram make absolutely no suggestion whatsoever that would motivate one skilled in the art to vary the temperatures between baking steps, much less suggest that one should be at a higher temperature than the other. Thus, absent some teaching in Akram specifically stating that the temperature used for the asserted second soft-baking step is higher than the temperature used for the asserted first soft-baking step, Akram cannot support an anticipation rejection of independent claim 30 under Section 102.

For at least the reasons discussed above, no *prima facie* case of anticipation is believed to exist with regard to independent claim 30 based upon Akram. Accordingly, Applicants respectfully request that the Examiner withdraw the Section 102 rejection and allow independent claim 30 and those claims depending therefrom.

Rejections under 35 U.S.C. § 103

In the Office Action, the Examiner additionally rejected dependent claims 3, 4, 7, 11, 29, and 31 under 35 U.S.C. § 103(a) as being unpatentable over Akram. Applicants respectfully traverse these rejections.

Legal Precedent

The burden of establishing a *prima facie* case of obviousness falls on the Examiner. *Ex parte Wolters and Kuypers*, 214 U.S.P.Q. 735 (PTO Bd. App. 1979). To establish a *prima facie* case, the Examiner must not only show that the combination includes *all* of the claimed elements, but also a convincing line of reason as to why one of ordinary skill in the art would have found the claimed invention to have been obvious in light of the teachings of the references. *Ex parte Clapp*, 227 U.S.P.Q. 972 (B.P.A.I. 1985). In addressing obviousness determinations under 35 U.S.C. § 103, the Supreme Court in *KSR International Co. v. Teleflex Inc.*, No. 04-1350 (April 30, 2007), reaffirmed many of its precedents relating to obviousness including its holding in *Graham v. John Deere Co.,* 383 U.S. 1 (1966). In *KSR*, the Court also reaffirmed that "a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *Id.* at 14. In this regard, the *KSR* court stated that "it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does … because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known." *Id.* at 14-15.

Furthermore, the *KSR* court did not diminish the requirement for objective evidence of obviousness. *Id.* at 14 ("To facilitate review, this analysis should be made explicit. See *In re Kahn*, 441 F.3d 977, 988 (CA Fed. 2006) ("[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness"). As our precedents make clear, however, the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ."); *see also, In re Lee*, 61 U.S.P.Q.2d 1430, 1436 (Fed. Cir. 2002) (holding that the factual inquiry whether to combine references must be thorough and searching, and that it must be based on *objective evidence of record*).

Deficiencies of the Rejection

Claims 3, 4, 7, 11, 29, and 31 each depend from either independent claim 1 or independent claim 30, which were both rejected by the Examiner under Section 102 based solely upon Akram. As discussed above, however, Akram fails to teach each and every feature recited by independent claims 1 and 30. Namely, Akram fails to teach or suggest (1) soft-baking a semiconductor wafer having at least one unfilled void present under a layer of resist and between two features, and (2) soft-baking a substrate at a second higher temperature after soft-baking the substrate at a first temperature that is lower than the second temperature.

In the Section 103 rejection of claims 3, 4, 7, 11, 29, and 31, the Examiner failed to cite any secondary references to remedy the deficiencies of Akram. As such, each of claims 3, 4, 7, 11, 29, and 31 are believed to be clearly patentable at least by virtue of their dependency from either independent claim 1 or independent claim 30. Additionally, claims 3, 4, 29, and 31 are also believed to be allowable over Akram based upon their separately recited subject matter, as discussed further below.

Dependent Claim 3

Dependent claim 3 depends from claim 1 and recites "wherein during the first predetermined period of time: the resist hardens; and air trapped in the at least one unfilled void under the resist does not possess sufficient energy to expand through the resist." (Emphasis added). In rejecting dependent claim 3 under Section 103, the Examiner admitted that Akram does not specifically disclose that air trapped in at least one unfilled void does not possess sufficient energy to expand through a resist layer. *See* Final Office Action, page 4. However, the Examiner asserted that it would have been obvious to one of ordinary skill in the art to conclude that since the resist of Akram hardens during the first soft-bake (step 18), air trapped under the resist would not possess sufficient energy to expand through the resist. *See id.* Applicants respectfully disagree.

As discussed above, in accordance with the soft-baking techniques of Akram, any unfilled voids that are initially present between surface features 26 of the substrate 24 are filled with the resist 34 due to the vibrating process (e.g., steps 14 and optional step 16) performed *prior* to the asserted first soft-baking step 18. Thus, by the time the asserted first soft-bake (step 18) is performed, no unfilled voids are present under the resist, as any such voids would have already been filled during the preceding vibrating steps. As such, there does not appear to be any basis for the Examiner's assertion that one skilled in the art would conclude that the asserted first soft-baking step would prevent air trapped in voids under the resist from expanding through the resist, as Akram clearly states that such voids are filled, and thus do not contain trapped air, *prior* to the asserted first soft-baking step being performed.

Accordingly, while claim 3 is believed to be clearly patentable at least by virtue of its dependency from independent claim 1, Applicants believe that claim 3 is also allowable over Akram in view of the subject matter separately recited.

Dependent Claim 4

Dependent claim 4 depends from claim 1 and recites "wherein during the first predetermined period of time: the resist remains fluid; and air trapped in the at least one unfilled void under the resist expands through the resist to the surface; and the resist flows back to its original conformal shape." (Emphasis added). Thus, like dependent claim 3, dependent claim 4 recites the presence of an unfilled void under a resist layer. In rejecting dependent claim 4 under Section 103, the Examiner admitted that Akram does not specifically disclose that air trapped in at least one unfilled void expands through a resist layer, but asserted that one skilled in the art would have found it obvious to conclude that during the asserted first soft-baking step, that the resist 34 remains partially fluid to allow air trapped under the resist to expand through the resist. *See* Final Office Action, page 4. Again, Applicants disagree.

As discussed above, Akram teaches performing the asserted first soft-bake step 18 on a substrate that contains no unfilled voids. Particularly, the vibration steps 14 and 16, which are described as being performed *prior* to the asserted first soft-bake step 18, causes any unfilled voids to be filled with the resist material 34. As the Examiner can appreciate, a void filled with a resist 34 would not contain trapped air, as the resist 34 would have caused any trapped air to be displaced or expelled from the void. Thus, by the time the asserted first soft-bake (step 18) is performed, no unfilled voids containing trapped air would be present under the resist. As such, there does not appear to be any basis for the Examiner's assertion that one skilled in the art would conclude that the asserted first soft-baking step would allow air trapped in voids under the resist to expand through the resist, as Akram clearly states that such voids are filled, and thus do not contain trapped air, prior to the asserted first soft-baking step being performed.

Accordingly, while claim 4 is believed to be clearly patentable at least by virtue of its dependency from independent claim 1, Applicants believe that claim 4 is also allowable over Akram in view of the subject matter separately recited.

Dependent Claims 29 and 31

Dependent claims 29 and 31 depend from independent claims 1 and 30, respectively, and each recite that subsequent to acts (a) (e.g., first soft-baking step) and (b) (e.g., second soft-baking step), at least one unfilled void remains present under the resist. Applicants respectfully submit that this recited feature is not disclosed or rendered obvious in view of Akram.

In rejecting claims 29 and 31, the Examiner admitted that this feature is absent from Akram, but alleged that it would have been obvious to one of ordinary skill in the art to conclude that an unfilled void would remain between a plurality of features under a resist layer after soft-baking a substrate. *See* Final Office Action, page 6. Here again, Applicants respectfully disagree. As mentioned above, Akram discloses a technique in which all voids are filled by a resist (e.g., during to vibration steps 14 and 16) before the asserted first and second soft-baking steps 18 and 22 are performed. Thus, the asserted soft-baking steps of Akram are clearly carried out on a substrate that does not contain unfilled voids, as any such unfilled voids would have been removed by the vibration steps 14 and 16 prior the asserted soft-baking steps 18 and 22.

Accordingly, while claims 29 and 31 are believed to be clearly patentable at least by virtue of their respective dependencies from independent claims 1 and 30, Applicants believe that claims 29 and 31 would also be allowable over Akram in view of the subject matter separately recited.

Conclusion

In view of the remarks set forth above, Applicants respectfully request reconsideration of the Examiner's rejections and allowance of all pending claims. If the Examiner believes that a telephonic interview will help speed this application toward issuance, the Examiner is invited to contact the undersigned at the telephone number listed below.

General Authorization for Extensions of Time

In accordance with 37 C.F.R. § 1.136, Applicants hereby provide a general authorization to treat this and any future reply requiring an extension of time as incorporating a request therefor. Furthermore, Applicants authorize the Commissioner to charge the appropriate fee for any extension of time to Deposit Account No. 06-1315; Order No. MICS:0117/MAN (02-1051).

Respectfully submitted,

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